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<b>UTILITY PATENT APPLICATION TRANSMITTAL</b> <small>(Only for new nonprovisional applications under 37 CFR 1.53(b))</small>	<b>Attorney Docket No.</b>	<b>DOT1340</b>	<b>(103193-159973)</b>
	<b>First Inventor or Application Identifier.</b>		<b>J. McDonough et al.</b>
	<b>Title</b>	<b>System and Method for Assigning Combiner Channels in Spread Spectrum Communications</b>	
	<b>Express Mail Label No.</b>	<b>EL213565032US</b>	

<b>APPLICATION ELEMENTS</b> <small>See MPEP chapter 600 concerning utility patent application contents.</small>	<b>ADDRESS TO:</b> Assistant Commissioner for Patents Box Patent Application Washington, D.C. 20231
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<b>Name (Print/Type)</b>	Terrance A. Meador	<b>Registration No. (Attorney/Agent)</b>	30,298
<b>Signature</b>	<i>Terrance A. Meador</i>	<b>Date</b>	25 August 2000

## SYSTEM AND METHOD FOR ASSIGNING COMBINER CHANNELS IN SPREAD SPECTRUM COMMUNICATIONS

### Background of the Invention

5           The present invention relates generally to the field of spread spectrum communications and, more particularly, for assigning combiner channels to the soft symbols of an information channel following demodulation in a code division multiple access (CDMA) RAKE receiver.

10           In spread spectrum communications, such as in CDMA systems, pseudorandom noise (PN) sequences are used to generate spread spectrum signals by increasing the bandwidth (i.e., spreading) of a baseband signal. A forward link waveform transmitted by the base station may be comprised of a pilot waveform and a data waveform. Both of the waveforms are received with the same relative phase and amplitude  
15           distortions introduced by the channel. The pilot waveform is an unmodulated PN sequence which aids in the demodulation process, as is well-known in the art as "pilot-aided demodulation." Conventional pilot-aided demodulation methods typically include the steps of (i) demodulating the pilot waveform, (ii) estimating the relative phase and  
20           amplitude of the pilot waveform, (iii) correcting the phase of the data waveform using the estimated phase of the pilot waveform, and (iv) adjusting the weight of data symbols used in maximal ratio combining in a RAKE receiver based on the estimated amplitude of the pilot waveform. Steps (iii) and (iv) above are performed as a "dot product" as is known in  
25           the art. Conventionally, steps (i) through (iv) are performed in hardware. In some conventional methods, a controller having a central processing

unit (CPU) and and/or a digital signal processor (DSP) performs some of the above-described steps.

Fig. 1 illustrates a conventional IS-95 forward link base station transmitter 10 (prior art). A pilot channel 12 is generated that has no data. That is, the data is predetermined to be all "0" bits. The pilot channel is modulated, or covered with a Walsh code from Walsh code generator 14 at 1.2288 Mcps (megachips per second). 64 orthogonal Walsh codes, each of 64 bits, are used in the IS-95A and 95B systems. Walsh code  $H_0$  is used to modulate the pilot channel.

Also depicted is a traffic or paging channel, which shall be referred to herein as an information channel. Data is input at one of a plurality of data rates from 9.6 kbps (kilobits per second) to 1.2 kbps. The data is encoded at encoder 16, at one bit per two code symbols, so that the output of the encoder 16 varies from 19.2 kbps (kilobits per second) to 2.4 kbps. Symbol repetition device 18 repeats the codes from 1 to 8 times to create a 19.2 kbps signal. Alternately stated, either 1, 2, 4, or 8 modulation symbols are created per code symbol. Then, the information channel is scrambled with a long code at the same 19.2 kbps rate. Other rates are described in the IS-2000 standard. The information channel is covered with a different Walsh code from that used to cover the pilot channel, code  $H_T$  for example.

After being modulated with Walsh codes, each channel is spread with a common short code, or PN sequence. Each channel is split into I and Q channels, and spread with I and Q channel PN sequences. A 90 degree phase shift is introduced by multiplying the I channels with a

sin function, while the Q channel is being multiplied with a corresponding cosine function. Then, the I and Q channels are summed into a QPSK channel. In the IS-95 standard, the same baseband symbols are assigned to both the I and Q channels. The combination of all the QPSK channels, including pilot, synchronization, paging, and traffic channels can be considered a composite waveform. This composite waveform is then up-converted in frequency (not shown) and transmitted.

Fig. 2 is a conventional IS-95 CDMA receiver (prior art). At the mobile station receiver 50 the transmitted signals are accepted as analog information, split into I and Q channels, multiplied respectively by sin and cosine functions, and converted into a digital I and Q sample stream at A/D 52. Conventionally, a multi-finger RAKE is used to resolve multipath variations, or delays in the sample stream, so that degradation due to fading can be minimized. Three demodulating fingers, demodulating finger 1 (54), demodulating finger 2 (56), and demodulating finger 3 (58) all receive the same I and Q sample stream, which has been represented as a single line for simplicity. Each demodulating finger is assigned one of the sample stream multipath delays. PN codes and Walsh codes are generated with delays consistent with the multipath delays of the sample stream to be demodulated. The sample stream from the multipaths is coherently combined in combiner 60 based on a maximal ratio combining (MRC) principle.

The receiver 50 may also receive the same sample stream from more than one base station. The base stations are precisely timed and synchronized using offsets of the PN spreading code. That is, the

same sample stream received from two different base stations is offset by delays that are typically much larger than multipath delays. The receiver 50 has diversity characteristics which permit it to demodulate the sample stream from two different base stations, for the purposes of a handoff for example.

In some conventional CDMA RAKE receivers, the outputs of multiple demodulating fingers are "hardwired" to combine the common information channels in a sample stream. The decision and data transfer operations of the individual finger channels are predetermined.

10 Hardwiring reduces flexibility, as the finger channels of the demodulating fingers must always be combined with the same partner finger channels. As shown in Fig. 2, the first finger channel of each demodulating finger is permanently connected to the first combiner channel. Likewise, the second and third finger channels of each demodulating finger are  
15 connected, respectively, to the second and third combiner channels. Thus, the number of information channels, the information channel order, and the information channels that can be combined across demodulating fingers are necessarily constricted when the finger channel outputs are connected in a hardwired arrangement. Hardwiring does not permit  
20 partner finger channels to be used with different combiner channels. Such a configuration necessitates the use of many demodulating fingers to process IS-2000 standard communications, as the standard includes sample streams with many information channels. A receiver with a fixed number of finger channels in each demodulating finger can only

demodulate such a fixed number of IS-2000 standard information channels.

Alternately, the soft symbols output by the demodulating finger can be buffered and transferred, via a data bus, to a CPU or DSP for combining. This software combining approach provides flexibility, as potentially the finger channels can be combined in any variation. However, the CPU or DSP may not have enough bandwidth to compete with the speed of the hardware combining solutions, nor will such solutions prove power efficient.

It would be advantageous if a CDMA RAKE receiver could be devised with great flexibility in the assignment of information channels to finger channels and demodulating fingers.

It would be advantageous if the subsequent combining of the soft symbols output by finger channels in a demodulating finger could be varied in response to the number of information channels in a sample stream.

It would be advantageous if the soft symbols output by finger channels in a plurality of demodulating fingers could be flexibly combined so that finger channels were not teamed together in permanent relationships.

It would be advantageous if the soft symbols of demodulated information channels could be flexibly combined without significant processor steps or large amounts of system overhead to store and direct the transfer of these soft symbols.

## SUMMARY OF THE INVENTION

Accordingly, in a spread spectrum communications integrated circuit receiver, a system for demodulating a plurality of information channels in a sample stream is provided. The system

5 comprises a plurality of demodulating fingers, where each demodulating finger accepts a sample stream, supplies soft symbols from demodulated information channels, and supplies combiner channel assignments for the soft symbols. The demodulating finger accepts combiner channel assignments, and assigns combiner channels to soft symbols in response

10 to the accepted combiner channel assignments. Each demodulating finger further includes at least one channel register to accept, store, and supply the combiner channel assignments with the soft symbols. More specifically, the combiner channel assignments are accepted, and then supplied by the demodulating finger which supplies the soft symbols of

15 the corresponding demodulated information channels. That is, each demodulating finger supplies the channel assignments for the soft symbols that it outputs. Preferably, a controller supplies the combiner channel assignments to the plurality of demodulating fingers, where each combiner channel assignment respectively corresponds to an information

20 channel.

Each demodulating finger includes a plurality of finger channels. Each finger channel demodulates a particular information channel and then, supplies the soft symbols from that demodulated information channel. Preferably, each finger channel includes its own

channel register to supply the combiner channel assignment  
corresponding to its demodulated information channel soft symbols.

When the integrated circuit receiver accepts a sample  
stream, with a plurality of sample stream (multipath) delays, each sample  
stream delay is processed by a corresponding demodulating finger. The  
sample stream delays include common information channels. Each  
demodulating finger assigns soft symbols from a common demodulated  
information channel to the same combiner channel. Alternately, when the  
receiver accepts a plurality of independent sample streams including a  
common information channel, each independent sample stream is  
processed by a corresponding demodulating finger, and each demodulating  
finger assigns soft symbols from the common demodulated information  
channel to the same combiner channel.

A method for combining a plurality of demodulated  
information channels in a sample stream is also provided. The method  
comprises: accepting a sample stream; demodulating information  
channels in the sample stream; and, supplying combiner channel  
assignments with the soft symbols of the demodulated information  
channels. As above, the combiner channel assignments correspond to  
information channels.

## BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 illustrates a conventional IS-95 forward link base  
station transmitter (prior art).

Fig. 2 is a conventional IS-95 CDMA receiver (prior art).



Fig. 3 is a schematic block diagram illustrating the present invention system for supplying combiner channel assignments for a plurality of demodulated information channels in a sample stream.

Fig. 4 illustrates a preferred channel register aspect of the invention.

Fig. 5 illustrates an exemplary combiner channel map, such as might be used by the controller to organize the assignment of information channels, through demodulating finger channels, to common combiner channels.

Fig. 6 is a schematic diagram which illustrates the results of the exemplary combiner channel map of Fig. 5.

Fig. 7 is a flowchart illustrating a method for combining a plurality of demodulated information channels in a sample stream, in a spread spectrum communications integrated circuit receiver.

Fig. 8 is a flowchart illustrating a variation of the method of Fig. 7.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Fig. 3 is a schematic block diagram illustrating the present invention system for supplying combiner channel assignments for a plurality of demodulated information channels in a sample stream. The system 100 is typically of use in a spread spectrum receiver, such as a direct sequence spread spectrum (DSSS) CDMA RAKE. Although the receiver is shown implemented as a collection of distinct hardware blocks it should be understood that the receiver is typically fabricated in a single

integrated circuit (IC), or a family of cooperating ICs. System 100 includes a plurality of demodulating fingers. Demodulating fingers A (102), demodulating finger B (104), and demodulating finger  $m$  (106) are shown, where  $m$  can be any whole number. That is, the present invention is not limited to any particular number of demodulating fingers, although in a preferred aspect of the invention  $m = 6$ .

Each demodulating finger, where demodulating finger A (102) is representative of the other demodulating fingers, accepts a sample stream input as defined in the explanation of Fig. 2, at a sample stream input. The sample stream includes a plurality of information channels, which can include traffic, paging, synchronization, and pilot channels. It is understood that the information channels in the sample stream include I and Q components, however for the sake of simplicity, the sample stream on line 108 is represented as a single line. Demodulating finger A (102) has soft symbol outputs to supply demodulated information channel soft symbols on lines 110a, 110b, through 110n, where  $n$  can be any whole number. The invention is not limited to any particular number of soft symbol outputs. The soft symbol outputs correspond to finger channels, as explained below. Demodulating finger A (102) also has a combiner channel assignment output on line 112. Typically, the information on lines 110a, 110b, 110n, and 112 is combined in a bus, represented by line 114. Similar output lines (buses) 116 and 118 exist for demodulating finger B (104) and demodulating finger  $m$  (106), respectively, for connection to combiner 119.

The combiner channel assignments are received by demodulating finger A (102) at a combiner channel assignment input on line 120, which is also connected to demodulating finger B (104) and demodulating finger *m* (106). The assignment of combiner channels by demodulating finger A (102) to the output soft symbols is responsive to the combiner channel assignments accepted on line 120. It should be understood that lines 114, 116, and 118 represent configurable information flow, and are not hardwired connections as described in the explanation of the prior art in Fig. 2. For example, a digital information bus may connect all the demodulating finger outputs to the combiner input. The information supplied by each demodulating finger can be a message that includes a portion for data (soft symbols) and a portion for address (combiner channel).

Demodulating finger A (102) includes at least one channel register 122 having an input connected to the demodulating finger combiner channel input on line 120 to accept combiner channel assignments. The channel register 122 has an output coupled to the demodulating finger combiner channel assignment output on line 112, and ultimately line 114, to supply stored combiner channel assignments. Demodulating finger A (102) supplies combiner channel assignments from a plurality of possible combiner channel assignments. Each combiner channel assignment corresponds to a particular information channel from plurality of information channels.

Demodulating finger A (102) further includes a plurality of finger channels. Finger channels 1 (124), finger channel 2 (126), through

finger channel  $n$  (128), where  $n$  can be any whole number, are shown, although the present invention is not limited to any particular number of finger channels. As shown in the figure, each finger channel 124-128 has a sample stream input coupled to the demodulating finger sample stream input to accept the sample stream on line 108. Each finger channel 124-128 also includes a soft symbol output connected to the demodulating finger soft symbol output on lines 110a-110 $n$  to supply soft symbols from a demodulated information channel.

Fig. 4 illustrates a preferred channel register aspect of the invention. Although only demodulating finger A (102) is shown, it is representative of the other demodulating fingers in the plurality of demodulating fingers. In this embodiment, each of the finger channels 124-128 further includes, respectively, channel registers 122a, 122b, and 122n. Each of the finger channels has a combiner channel assignment input connected to the channel register input on line 120 to accept and store a combiner channel assignment. Each combiner channel assignment corresponds to the information channel being demodulated by that finger channel. The demodulating finger channel assignment output is connected to the channel register output of each finger channel. Each finger channel register output supplies the combiner channel assignment corresponding to the demodulated information channel soft symbols being supplied by that particular finger channel.

Each finger channel 124-128 further includes a code input to accept an uncovering code. Typically, one code is provided from a plurality of uncovering codes on line 130, and that one uncovering code

corresponds to a particular information channel, from the plurality of information channels. As is well understood, each information channel is associated with one or more Walsh codes which uncover a corresponding information channel in the sample streams. That is, each finger channel  
5 124-128 demodulates an information channel in response to the receipt of a corresponding uncovering code.

Returning briefly to Fig. 3, the system 100 further comprises a controller 132 having an output on line 120 connected to the combiner channel input of each demodulating finger to supply a plurality of  
10 combiner channel assignments. A controller 132, although not explicitly shown, can also be included with the embodiment of Fig. 4 as the source of the combiner channel assignments. Again it must be understood that each combiner channel assignment corresponds to an information channel.

15 Fig. 5 illustrates an exemplary combiner channel map, such as might be used by the controller 132 to organize the assignment of common information channels, through demodulating finger channels, to common combiner channels. Alternately stated, a common information channel among demodulating fingers is assigned to the same combiner  
20 channel. As shown, information channel 1, is assigned to combiner channel 1, after processing by demodulating fingers 102-106. Specifically, information channel 1 is being demodulated by: finger channel 1 (124) of demodulating finger A (102); finger channel 2 (142) of demodulating finger B (104); and finger channel  $n$  (150) of demodulating finger  $m$  (106).

Fig. 6 is a schematic diagram which illustrates the results of the exemplary combiner channel map of Fig. 5. The present invention permits the soft symbols of demodulated information channel 1, which are demodulated by: finger channel 1 (124) of demodulating finger A (102);  
5 finger channel 2 (142) of demodulating finger B (104); and finger channel  $n$  (150) of demodulating finger  $m$  (106), to be combined into combiner channel 1. Note that the aspects of the invention presented in Figs. 5 and 6 above, apply equally well to the channel register embodiments of both Figs. 3 and 4.

10 To further illustrate the invention with examples, it is well known that a carrier signal is received as a plurality of carrier signal variations or delays which correspond to multipath. After down-conversion into a sample stream, the receiver accepts the sample stream, with a plurality of sample stream delays corresponding to the carrier  
15 signal multipath delays. Then, selected sample stream delays from the plurality of sample stream delays are processed by corresponding demodulating fingers, selected from the plurality of demodulating fingers. The demodulating fingers assign soft symbols from a common demodulated information channel to the same combiner channels.

20 Returning to Figs. 3 and 4, in a more specific example, the sample stream includes a first and a second delay, as well as a first information channel (information channel 1). Demodulating finger A (102) receives the assignment of a first combiner channel (combiner channel 1) to information channel 1. Demodulating finger A (102)  
25 demodulates information channel 1 in the sample stream with the first

delay and assigns the soft symbols from demodulated information channel 1 to combiner channel 1. Demodulating finger B (104) receives the assignment of combiner channel 1 to information channel 1.

Demodulating finger B (104) demodulates information channel 1 in the sample stream with the second delay and assigns soft symbols from the demodulated information channel 1 combiner channel 1.

Alternately, the receiver may accept a plurality of independent sample streams, where the independence is established by the use of different frequency carrier signals. This present example excludes the effects of multipath. These independent sample streams include common information channels. Each independent sample stream is processed or demodulated by a corresponding demodulating finger, from the plurality of demodulating fingers. Each demodulating finger assigns soft symbols from a common demodulated information channel to the same combiner channel. The independent sample streams may include a plurality of common information channels.

More specifically, a first sample stream, independent of a second sample stream is received, with a common first information channel (information channel 1). Demodulating finger A (102) receives the assignment of a first combiner channel (combiner channel 1) to information channel 1. Demodulating finger A (102) demodulates information channel 1 in the first sample stream and assigns soft symbols from information channel 1 to combiner channel 1. Demodulating finger B (104) receives the assignment of combiner channel 1 to information channel 1. Demodulating finger B (104) demodulates information channel

1 in the second sample stream and assigns soft symbols from demodulated information channel 1 to combiner channel 1.

Fig. 7 is a flowchart illustrating a method for combining a plurality of demodulated information channels in a sample stream, in a spread spectrum communications integrated circuit receiver. Although the method is described as a sequence of numbered steps for the purpose of clarity, no order should be inferred from the numbering unless explicitly stated. The method starts at Step 200. Step 202 accepts a sample stream. Step 204 demodulates information channels in the sample stream. Step 206 is a product, where combiner channel assignments are supplied with the soft symbols of the demodulated information channels.

In some aspects of the invention a further step, Step 203a accepts combiner channel assignments, typically a plurality of combiner channel assignments, where each combiner channel assignment corresponds to a particular information channel from the plurality of information channels. Then, supplying combiner channel assignments with soft symbols in Step 206 includes supplying combiner channel assignments, where each combiner channel assignment corresponds to a demodulated information channel.

In some aspects of the invention a further step, Step 203b stores the accepted combiner channel assignments in a register. The supplying of combiner channel assignments in Step 206 includes supplying the combiner channel assignments from the register.



Step 203c accepts an uncovering code, and demodulating information channels in Step 204 includes demodulating an information channel in response to accepting an uncovering code. Typically, the sample stream includes each information channel being modulated with a covering code from a plurality of covering codes. Then, accepting an uncovering code in Step 203c includes accepting an uncovering code corresponding to the information channel to be demodulated.

As explained above, in some aspects of the invention, Step 201a accepts a carrier signal with a plurality of multipath delays. Step 201b converts the carrier signal into a sample stream with a plurality of corresponding delays, so that accepting the sample stream in Step 202 includes accepting a sample stream with a plurality of sample stream delays. Then, Step 203d assigns selected sample stream delays to parallel demodulation paths. Demodulating information channels in Step 204 includes demodulating a common information channel in each parallel demodulation path, and wherein supplying combiner channel assignments with the soft symbols in Step 206 includes supplying combiner channel assignments from each parallel demodulation to the same combiner channel.

Fig. 8 is a flowchart illustrating a variation of the method of Fig. 7. Step 201c accepts a plurality of independent carrier signals including a common information channel. Step 201d converts the plurality of independent carrier signals into corresponding plurality of independent sample streams with a common information channel. Then, accepting a sample stream in Step 202 includes accepting a plurality of



independent sample streams with a common information channel. Step 203e assigns each independent sample stream to a parallel demodulation path. Demodulating information channels in Step 204 includes demodulating a common information channel in each parallel  
5 demodulation path, supplying combiner channel assignments with the soft symbols in Step 206 includes supplying combiner channel assignments from each parallel demodulation to the same combiner channel.

Returning to Fig. 7, in some aspects of the invention, the  
10 receiver includes a plurality of demodulating fingers. Then, accepting the sample stream in Step 202 includes each demodulating finger accepting the sample stream. Demodulating information channels in Step 204 includes each demodulating finger demodulating information channels in the sample stream. Supplying combiner channel assignments with the  
15 soft symbols in Step 206 includes each demodulating finger supplying the combiner channel assignments with the soft symbols.

In some aspects of the invention each demodulating finger includes a plurality of finger channels. Then, the supplying combiner channel assignments with the soft symbols in Step 206 includes each  
20 finger channel supplying a combiner channel assignment corresponding to the information channel being demodulated.

In some aspects of the invention the receiver includes a controller. Then, accepting combiner channel assignments in Step 203a includes each demodulating finger accepting combiner channel  
25 assignments from the controller.



A method for supplying combiner channel assignments, with the soft symbols of corresponding demodulated information channels is described. The grouping of combiner channel assignments with the soft symbols permits the assignment of any information channel, to any finger channel in a demodulating finger, or to any demodulating finger, without additional communications being required between the controller and the combiner. Once the demodulating finger is programmed with a combiner channel assignment for each finger channel, the assignment of finger channel outputs to combiner channels is regulated in the flow of communications between the demodulating finger and the combiner. A system for assigning combiner channels with the soft symbol outputs of a demodulating finger is also provided. Variations include a channel register to store combiner channel assignments that regulate each finger channel in the demodulating finger, or independent registers in each finger channel. Other variations and embodiments of the invention will occur to those skilled in the art

What is claimed is:

1. In a spread spectrum communications integrated circuit receiver supplying combiner channel assignments for a plurality of demodulated information channels in a sample stream, a system

5 comprising:

a plurality of demodulating fingers; and

wherein each demodulating finger has a sample stream input to accept a sample stream, a soft symbol output to supply soft symbols associated with demodulated information channels, and a combiner  
10 channel assignment output to supply combiner channel assignments for associated soft symbols.

2. The system of claim 1 wherein each demodulating finger further includes:

15 a combiner channel assignment input to accept combiner channel assignments; and

wherein the demodulating finger combiner channel assignment output assigns combiner channels to associated soft symbols in response to the accepted combiner channel assignments.

20

3. The system of claim 2 wherein each demodulating finger further includes:

at least one channel register having an input connected to the demodulating finger combiner channel assignment input to accept  
25 combiner channel assignments and an output connected to the

demodulating finger combiner channel assignment output to supply stored combiner channel assignments.

4. The system of claim 3 wherein each demodulating  
5 finger demodulates a plurality of information channels; and  
wherein each demodulating finger supplies combiner channel assignments for the soft symbols from the plurality of demodulated information channels.

10 5. The system of claim 4 wherein each demodulating finger further includes:  
a plurality of finger channels;  
wherein each finger channel includes a sample stream input coupled to the demodulating finger sample stream input to accept the  
15 sample stream and a soft symbol output connected to the demodulating finger soft symbols output to supply soft symbols from a demodulated information channel.

6. The system of claim 5 wherein each finger channel  
20 further includes a channel register, each finger channel having a combiner channel assignment input connected to the channel register input to accept and store a combiner channel assignment.

7. The system of claim 6 wherein each demodulating  
25 finger combiner channel assignment output is coupled to the channel

register output of each finger channel to supply the combiner channel assignment corresponding to the demodulated information channel soft symbols.

5                   8.     The system of claim 7 wherein each finger channel further includes a code input to accept an uncovering code, each finger channel demodulating an information channel in response to the receipt of a corresponding uncovering code.

10                   9.     The system of claim 2 further comprising:  
a controller having an output connected to the combiner channel assignment input of each demodulating finger to supply combiner channel assignments.

15                   10.    The system of claim 2 in which the receiver accepts a carrier signal, with a plurality of multipath delays, that is converted into a sample stream with a corresponding plurality of sample stream delays,  
wherein selected sample stream delays are assigned to corresponding demodulating fingers; and

20                   wherein common information channels from each sample stream delay are demodulated by the corresponding demodulating fingers into soft symbols which are assigned to common combiner channels.

11. The system of claim 10 in which the sample stream includes a first and a second delay, and also includes a first information channel;

wherein a first demodulating finger receives the assignment  
5 of a first combiner channel to the first information channel, the first demodulating finger demodulating the first information channel in the sample stream with the first delay and assigning soft symbols from the demodulated first information channel to the first combiner channel; and

wherein a second demodulating finger receives the  
10 assignment of a first combiner channel to the first information channel, the second demodulating finger demodulating the first information channel in the sample stream with the second delay and assigning soft symbols from the demodulated first information channel to the first combiner channel.

12. The system of claim 2 in which the receiver accepts a plurality of independent sample streams including common information channels;

wherein each sample stream from the plurality of  
20 independent sample streams is assigned to a corresponding demodulating finger from the plurality of demodulating fingers; and

wherein common information channels from each  
independent sample stream are demodulated by the corresponding demodulating fingers into soft symbols which are assigned to common  
25 combiner channels.



13. The system of claim 12 in which a first sample stream, independent of a second sample stream, is included, with a common first information channel;

5 wherein a first demodulating finger receives the assignment of a first combiner channel to the first information channel, the first demodulating finger demodulating the first information channel in the first sample stream and assigning soft symbols from the demodulated first information channel to the first combiner channel; and

10 wherein a second demodulating finger receives the assignment of a first combiner channel to the first information channel, the second demodulating finger demodulating the first information channel in the second sample stream and assigning soft symbols from the demodulated first information channel to the first combiner channel.

15 14. In a spread spectrum communications demodulating finger integrated circuit to supply combiner channel assignments for a plurality of demodulated information channels in a sample stream, the demodulating finger comprising:

20 a sample stream input to accept a sample stream;  
a soft symbol output to supply soft symbols from demodulated information channels; and

a combiner channel assignment output to supply combiner channel assignments for the soft symbols.

25



15. The demodulating finger system of claim 14 further comprising:

a combiner channel assignment input to accept combiner channel assignments; and

5 wherein the combiner channel assignment output assigns combiner channels for soft symbols in response to accepting combiner channel assignments.

16. The demodulating finger of claim 15 further comprising:

10 at least one channel register having an input connected to the demodulating finger combiner channel assignment input to accept combiner channel assignments and an output connected to the demodulating finger combiner channel assignment output to supply stored  
15 combiner channel assignments.

17. The demodulating finger of claim 16 wherein the demodulating finger supplies a plurality of combiner channel assignments, with each combiner channel assignment corresponding to  
20 information channels from the plurality of information channels.

18. The demodulating finger of claim 17 further comprising:  
a plurality of finger channels;

wherein each finger channel includes a sample stream input coupled to the demodulating finger sample stream input to accept the sample stream and a soft symbol output connected to the demodulating finger soft symbol output to supply soft symbols from a demodulated  
5 information channel.

19. The demodulating finger of claim 18 wherein each finger channel further includes a channel register, each finger channel having a combiner channel assignment input connected to the channel  
10 register input to accept and store a combiner channel assignment corresponding to the information channel being demodulated by that finger channel.

20. The demodulating finger of claim 19 wherein each  
15 demodulating finger further includes an output connected to the channel register output to supply the combiner channel assignment corresponding to the demodulated information channel soft symbols.

21. The demodulating finger of claim 20 wherein each  
20 finger channel further includes a code input to accept an uncovering code corresponding to an information channel, each finger channel demodulating an information channel from the plurality of information channels in response to the received uncovering code.

22. In a spread spectrum communications integrated circuit receiver, a method for supplying combiner channel assignments for a plurality of demodulated information channels in a sample stream, the method comprising:

- 5                    accepting a sample stream;
- demodulating information channels in the sample stream;
- and

                  supplying combiner channel assignments with the soft symbols of the demodulated information channels.

10

23. The method of claim 22 further comprising:

accepting combiner channel assignments; and

                  wherein supplying combiner channel assignments with soft symbols includes supplying combiner channel assignments corresponding

15

to demodulated information channels.

24. The method of claim 23 further comprising:

storing combiner channel assignments in a register; and

                  wherein supplying combiner channel assignments includes

20

supplying the combiner channel assignments from the register.

25. The method of claim 23 further comprising:

accepting an uncovering code; and

wherein demodulating information channels includes demodulating an information channel in response to accepting an uncovering code.

5                   26.    The method of claim 25 in which the sample stream includes each information channel being covered with a Walsh code from a plurality of Walsh codes; and

                  wherein accepting an uncovering code includes accepting an uncovering code corresponding to the information channel to be  
10 demodulated.

                  27.    The method of claim 23 further comprising:  
                  accepting a carrier signal with a plurality of multipath  
delays;  
15                   converting the carrier signal into a sample stream with a plurality of corresponding delays; and

                  wherein accepting the sample stream includes accepting a sample stream with a plurality of sample stream delays; and  
                  the method further comprising:  
20                   assigning selected sample stream delays to parallel demodulation paths;

                  wherein demodulating information channels includes demodulating a common information channel in each parallel demodulation path; and

wherein supplying combiner channel assignments with the soft symbols includes supplying combiner channel assignments from each parallel demodulation path to the same combiner channel.

- 5                   28.    The method of claim 23 further comprising:
- accepting a plurality of independent carrier signals including a common information channel;
- converting the plurality of independent carrier signals into a corresponding plurality of independent sample streams including a
- 10               common information channel; and
- wherein accepting a sample stream includes accepting a plurality of independent sample streams with a common information channel; and
- the method further comprising:
- 15               assigning each independent sample stream to a parallel demodulation path;
- wherein demodulating information channels includes demodulating a common information channel in each parallel demodulation path; and
- 20               wherein supplying combiner channel assignments with the soft symbols includes supplying combiner channel assignments from each parallel demodulation to the same combiner channel.

- 25               29.    The method of claim 23 in which the integrated circuit receiver includes a plurality of demodulating fingers; and

wherein accepting the sample stream includes each  
demodulating finger accepting the sample stream;

wherein demodulating information channels includes each  
demodulating finger demodulating information channels in the sample  
5 stream; and

supplying combiner channel assignments with the soft  
symbols includes each demodulating finger supplying the combiner  
channel assignments with the soft symbols.

10 30. The method of claim 29 in which each demodulating  
finger includes a plurality of finger channels; and

wherein supplying combiner channel assignments with the  
soft symbols includes each finger channel supplying a combiner channel  
assignment corresponding to the information channel being demodulated.

15 31. The method of claim 30 in which the integrated circuit  
receiver includes a controller; and

wherein accepting combiner channel assignments includes  
each demodulating finger accepting combiner channel assignments from  
20 the controller.

## SYSTEM AND METHOD FOR ASSIGNING COMBINER CHANNELS IN SPREAD SPECTRUM COMMUNICATIONS

### ABSTRACT OF THE DISCLOSURE

5           A method for providing combiner channel assignments, with the soft symbols of corresponding demodulated information channels, is presented. The grouping of combiner channel assignments with the soft symbols permits any information channel to be associated with any finger channel without additional communications being required between a

10   controller and the combiner. Once the demodulating finger is programmed with a combiner channel assignment for each finger channel, the assignment of finger channel outputs to combiner channels is regulated in the flow of communications between the combiner and the demodulating finger. A system for assigning combiner channels with the

15   soft symbol outputs of a demodulating finger is also provided.

10

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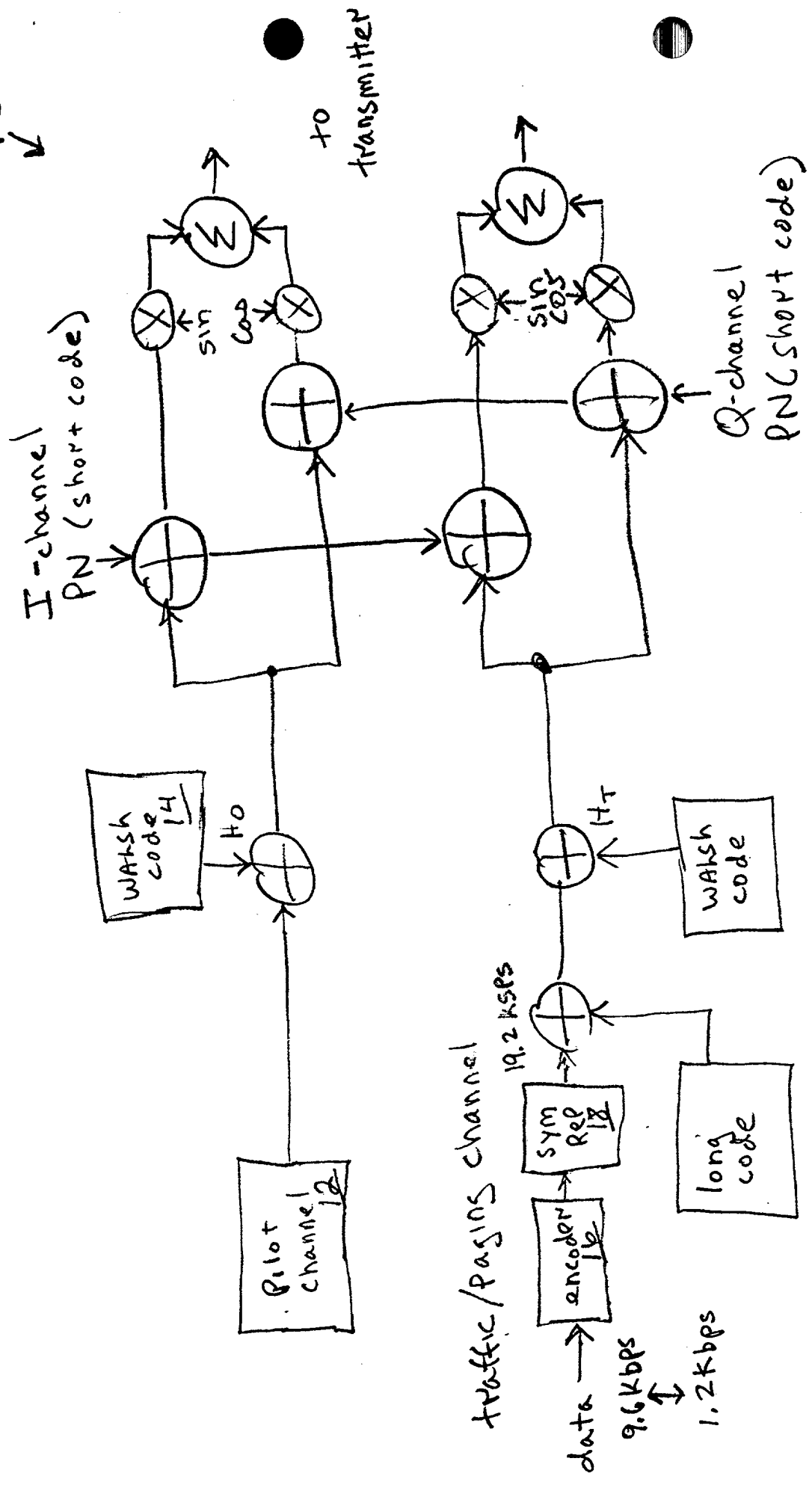


Fig. 1 (prior art)



542 demod finger 1

50

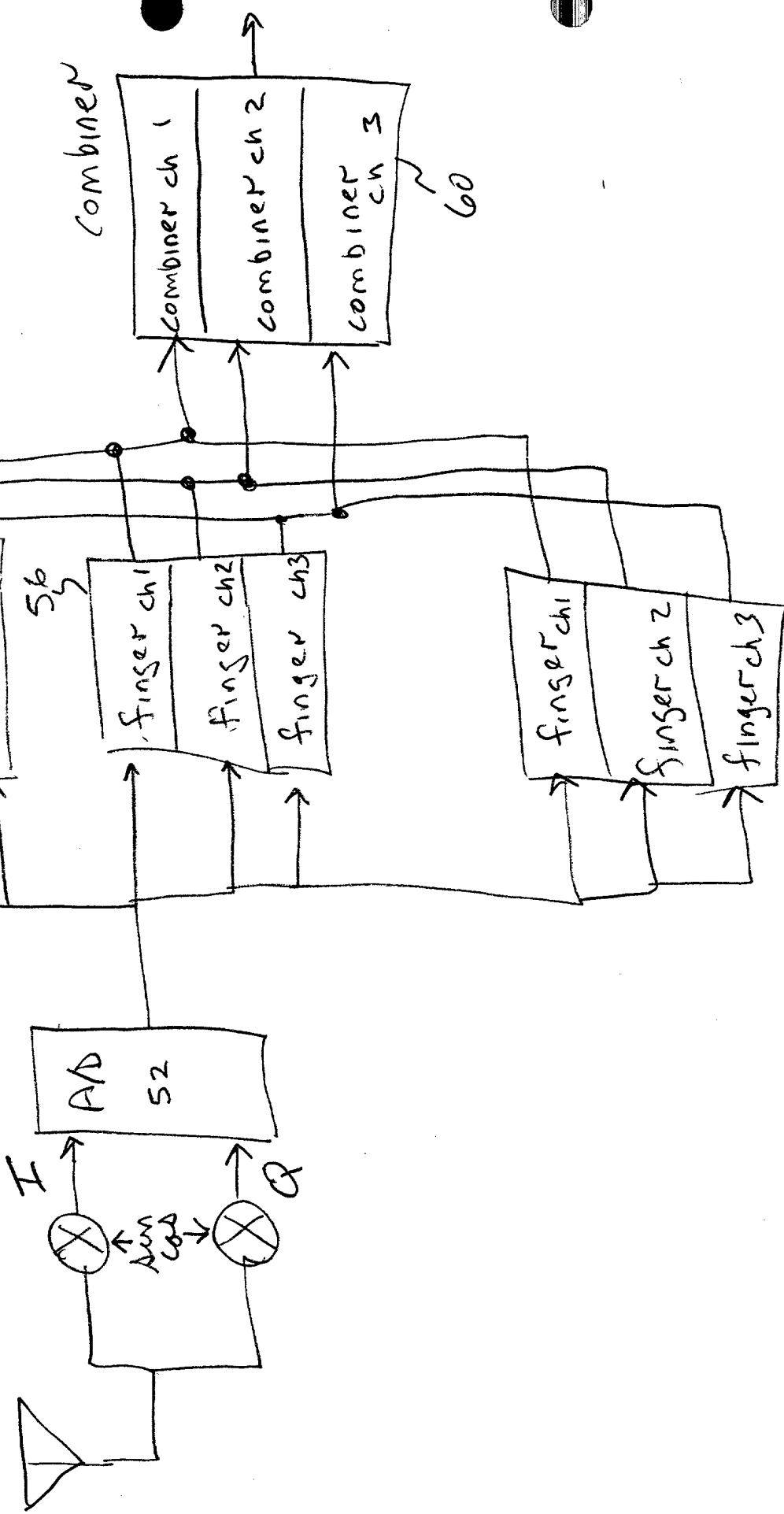


Fig. 2 (prior art)

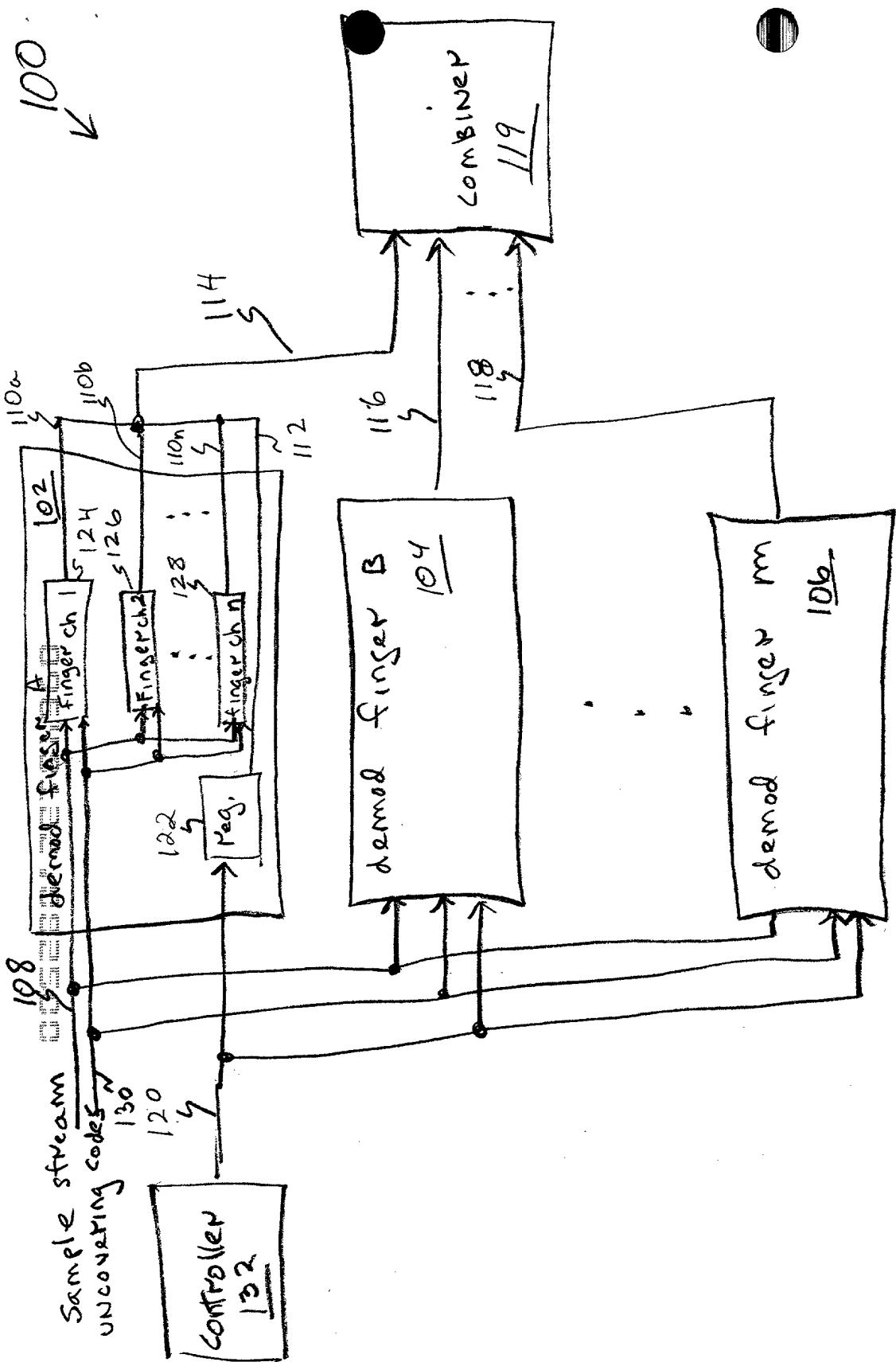


Fig. 3

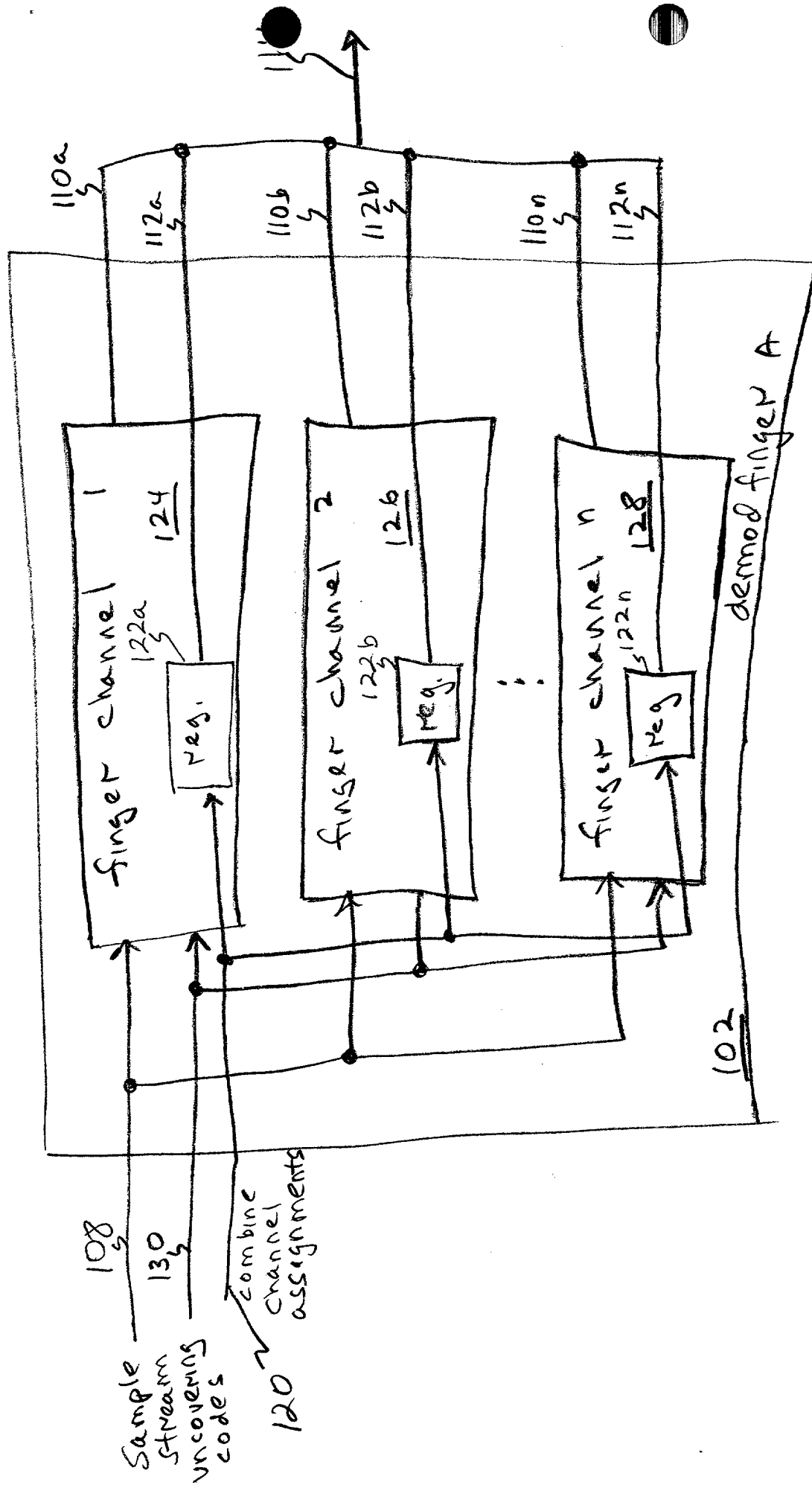


Fig. 4

info channel 1	combiner channel 1	demod finger A / finger channel 1 demod finger B / finger channel 2 demod finger m / finger channel n
info channel 2	combiner channel 2	demod finger A / finger channel 2 demod finger B / finger channel 1 demod finger m / finger channel 2
⋮	⋮	⋮
info channel n	combiner channel n	demod finger A / finger channel n demod finger B / finger channel n demod finger m / finger channel 1

Fig. 5

102

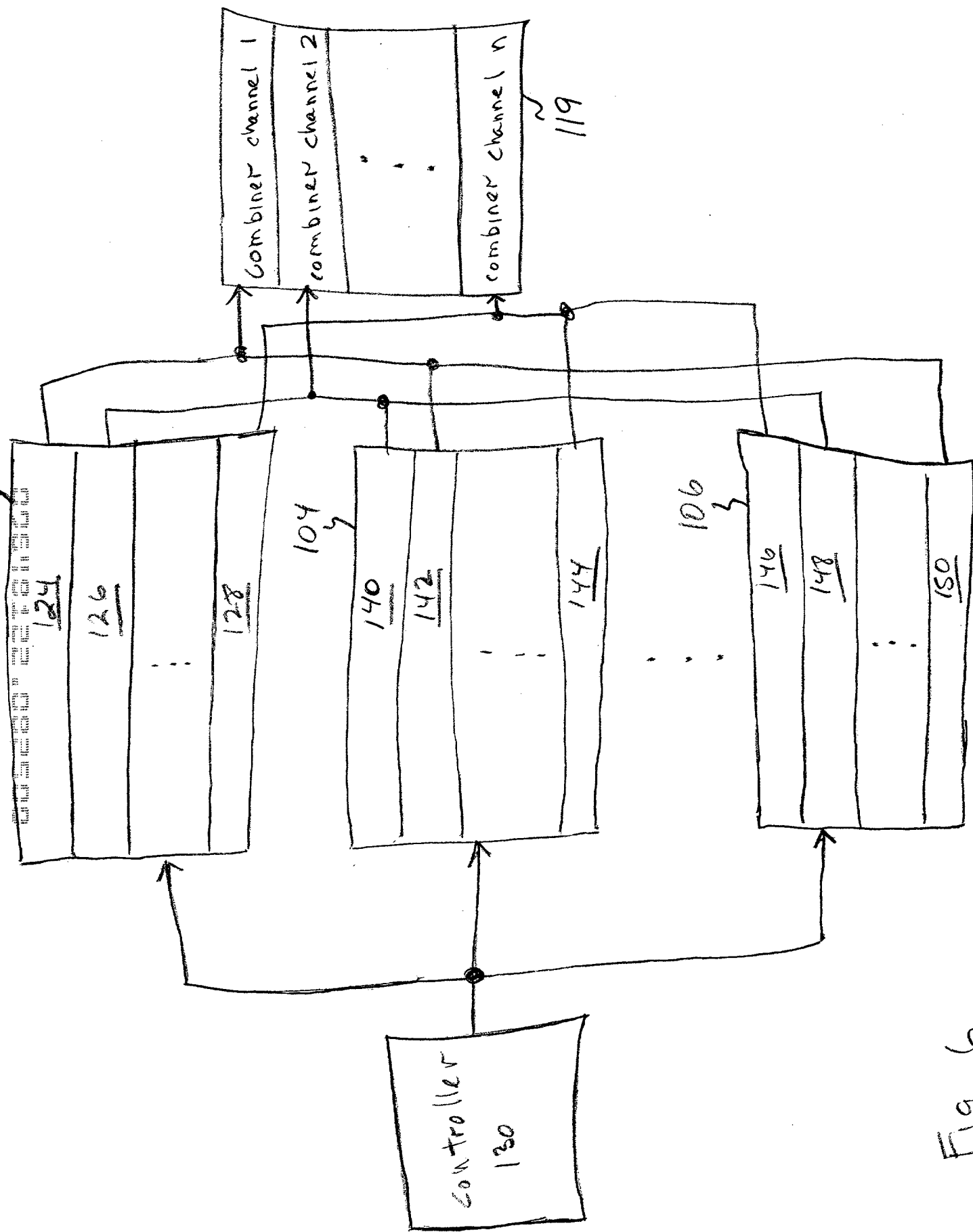


Fig. 6

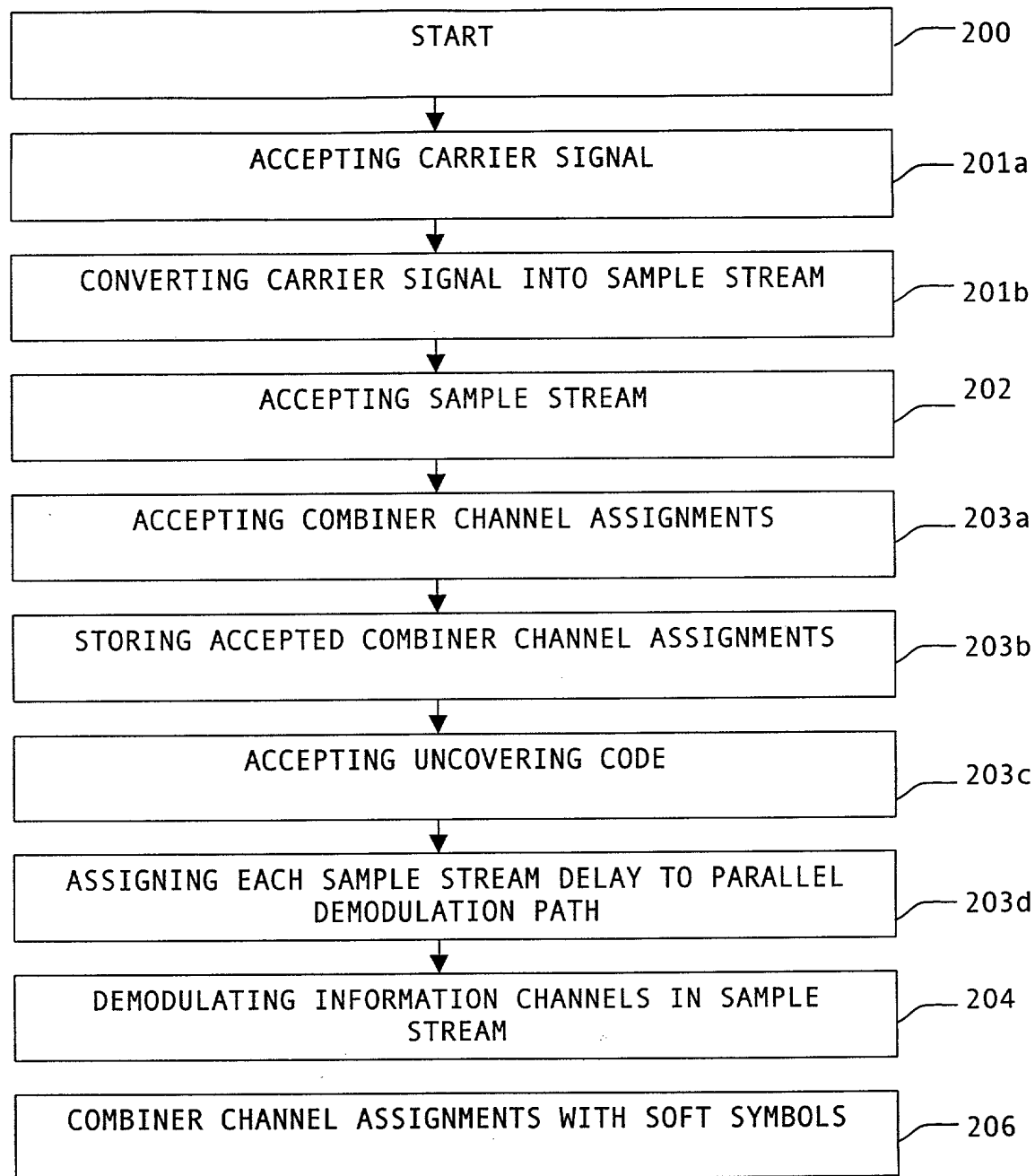


FIG. 7

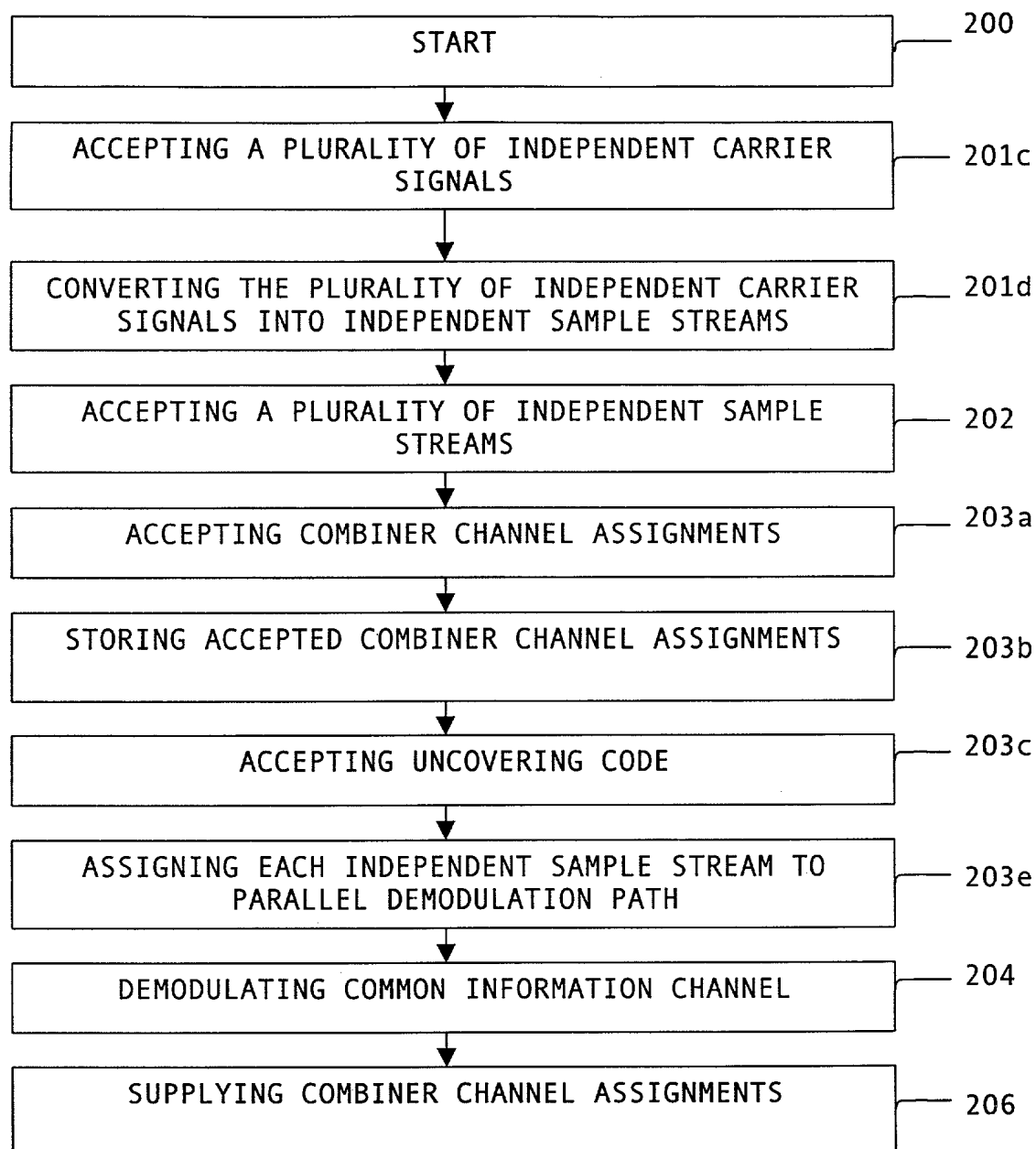


FIG. 8

**DECLARATION FOR PATENT APPLICATION**

  X   Declaration Submitted With Initial Filing      **OR**             Declaration Submitted After Initial Filing

As a below-named inventor, I hereby declare that:

My residence, post office address and citizenship is as stated below next to my name.

I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

**SYSTEM AND METHOD FOR ASSIGNING COMBINER CHANNELS IN SPREAD  
SPECTRUM COMMUNICATIONS**

the specification of which

  X   is attached hereto.

       was filed on                                 , 2000 as U.S. Application Serial No.                                   
and was amended on                                  if applicable (the "Application").

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability of the subject matter of the Application as defined in Title 37, Code of Federal Regulations ("C.F.R."), § 1.56.

I hereby claim foreign priority benefits under Title 35 United States Code § 119 (a)-(d) or § 365(b) of any foreign applications for patent or inventors certificate, or § 365(a) of any PCT international application which designated at least one country other than the United States of America listed below and have been identified below by checking the box, any foreign application for patent or inventor's certificate, or of any PCT international application having a filing date before that of the application on which priority is claimed.



Prior Foreign Application Numbers	Country	Foreign Filing Date (MM/DD/YYYY)	Priority Not Claimed	Certified Copy Attached	
				YES	NO

With respect to the Application, I hereby claim the benefit under 35 U.S.C. Section 119(e) of any United States provisional application(s) listed below:

Application Number(s)	Filing Date (MM/DD/YYYY)

With respect to the Application, I hereby claim the benefit under 35 U.S.C. Section 120 of any United States application(s), or Section 365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of the application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of 35 U.S.C. Section 112, I acknowledge the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability of the subject matter of the Application as defined in Title 37, C.F.R., Section 1.56 which became available between the filing date of the prior application and the national or PCT International filing date of the Application:

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As a named inventor, I hereby appoint the following registered practitioner(s) to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith:

JAMES P. CLEARY, Reg. No. 45,843  
TRAVIS L. DODD, Reg. No. 42,491  
CHARLES D. GAVRILOVICH, Jr. Reg. No. 41,031  
LISA A. HAILE, Reg. No. 38,347  
WILLIAM N. HULSEY III, Reg. No. 33,402  
RICHARD J. IMBRA, Reg. No. 37,643  
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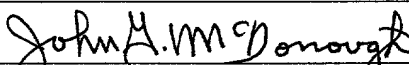
TERRANCE A. MEADOR, Reg. No. 30,298  
JOHN J. OSKOREP, Reg. No. 41,234  
STEPHEN E. REITER, Reg. No. 31,192  
WAYNE P. SOBON, Reg. No. 32,438  
STEVEN R. SPRINKLE, Reg. No. 40,825  
DAVID R. STEVENS, Reg. No. 38,626  
RAMSEY R. STEWART, Reg. No. 38,322  
MARK M. TAKAHASHI, Reg. No. 38,631  
BARRY N. YOUNG, Reg. No. 27,774

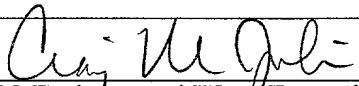
Please direct all correspondence to:

**Terrance A. Meador**  
**Gray Cary Ware & Freidenrich**  
**401 B Street, Suite 1700**  
**San Diego, CA 92101-4297**

**Phone: 619/699-2652 - Fax: 619/699-3452**

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

<b>Full Name of Sole Or First Inventor</b> (First, Middle, Family Name or Surname)	JOHN G. McDONOUGH	
<b>Inventor Signature</b>		<b>Date:</b> 8-22-00
<b>Residence Address</b>	7873 Via Capri, La Jolla, California 92037	
<b>Post Office Address</b>	same	
<b>Citizenship</b>	USA	

<b>Full Name of Second Inventor</b> (First, Middle, Family Name or Surname)	CRAIG M. JULIAN	
<b>Inventor Signature</b>		<b>Date:</b> 08/23/00
<b>Residence Address</b>	2108 Emberwood Way, Escondido, California 92029	
<b>Post Office Address</b>	same	
<b>Citizenship</b>	USA	

<b>Full Name of Third Inventor</b> (First, Middle, Family Name or Surname)		
<b>Inventor Signature</b>		<b>Date:</b>
<b>Residence Address</b>		
<b>Post Office Address</b>		
<b>Citizenship</b>		